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LIBERTY RESERVOIR, CARROLL AND BALTIMORE COUNTIES, MARYLAND

Pacific Northwest Environmental Research Laboratory

Prepared for:

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June 1975

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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REPORT

ON

LIBERTY RESERVOIR

CARROLL AND BALTIMORE COUNTIES

MARYLAND

EPA REGION III

WORKING PAPER No. 357

WITH THE COOPERATION OF THE

MARYLAND DEPARTMENT OF NATURAL RESOURCES,

MARYLAND DEPARTMENT OF HEALTH AND MENTAL HYGIENE,

AND THE

MARYLAND NATIONAL GUARD

JUNE, 1975

REPORT ON LIBERTY RESERVOIR

CARROLL AND BALTIMORE COUNTIES, MARYLAND, EPA REGION III

by

National Eutrophication Survey

Water and Land Monitoring Branch
Monitoring Applications Laboratory
National Environmental Research Center
Las Vegas, Nevada

and

Eutrophication Survey Branch
Pacific Northwest Environmental Research Laboratory
National Environmental Research Center
Corvallis, Oregon

Working Paper No. 357

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

June 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin

planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Maryland Department of Natural Resources and the Maryland Department of Health and Mental Hygiene for professional involvement and to the Maryland National Guard for conducting the tributary sampling phase of the Survey.

Paul W. Slunt, Chief, Water Quality Services, James T. Allison, Natural Resources Manager, Water Quality Services, of the Maryland Department of Natural Resources, and Earl S. Quance, Chief, Division of Water and Sewerage, Maryland Department of Health and Mental Hygiene provided invaluable lake documentation and counsel during the course of the Survey.

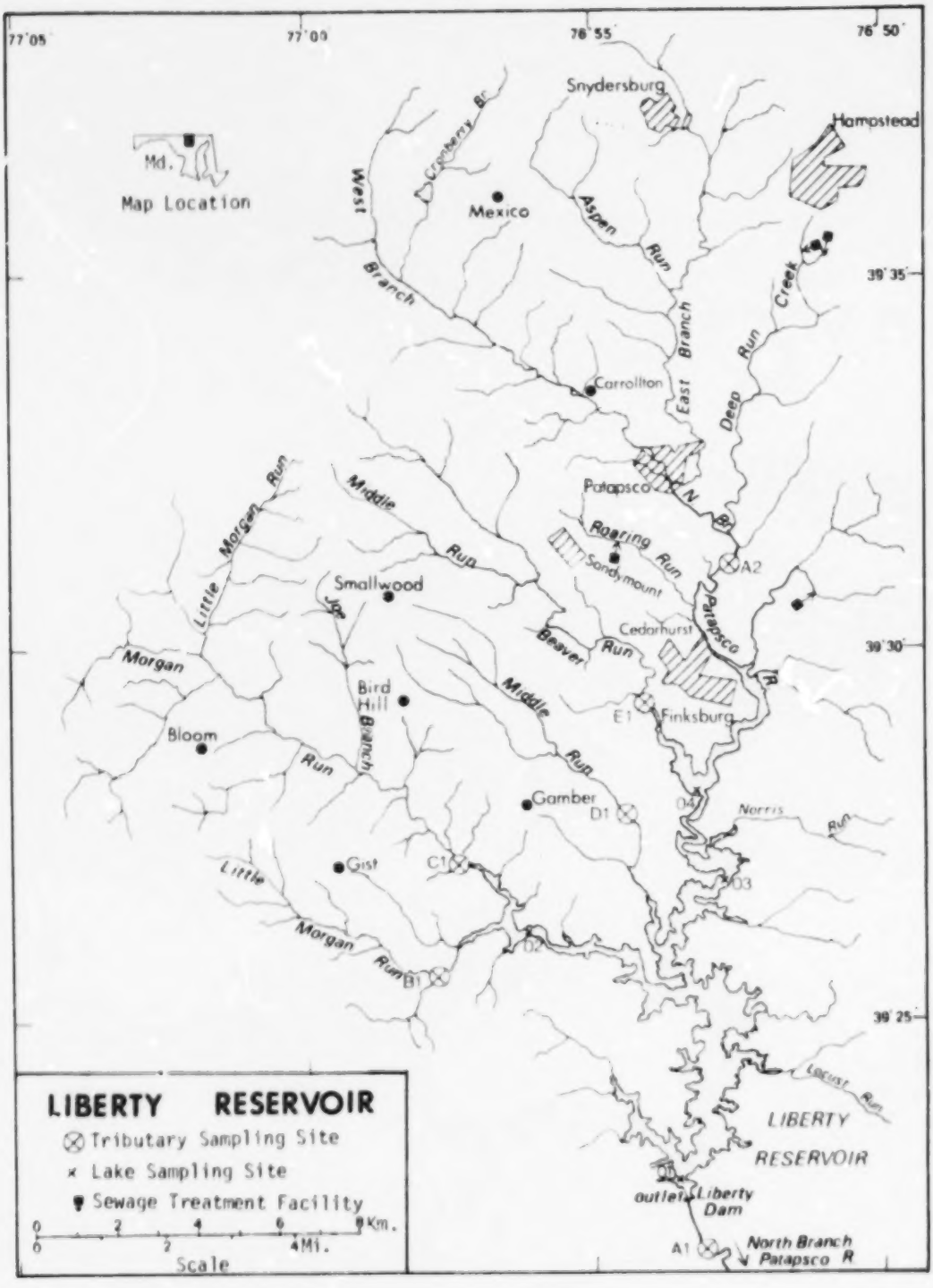
Major General Edwin Warfield III, the Adjutant General of Maryland, and Project Officer Colonel Bernard Feingold, who directed the volunteer efforts of the Maryland National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MARYLAND

LAKE NAME	COUNTY
Deep Creek Lake	Garrett
Liberty Reservoir	Carroll, Baltimore
Loch Raven Reservoir	Baltimore
Johnson Pond	Wicomico


77°05
77°00
76°55
76°50
39°35
39°30
39°25
Md.
Map Location
Snydersburg
Hampstead
Mexico
Carrollton
Patapsco
Smallwood
Cedarhurst
Finksburg
Sandymount
Bird Hill
Bloom
Gamber
Gist
Norris Run
Locust Run
LIBERTY RESERVOIR
outlet Liberty Dam
North Branch Patapsco R
A1
A2
B1
C1
D1
D2
D3
D4
E1
LIBERTY RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 2 4 6 8 Km.
0 2 4 Mi.
Scale

LIBERTY RESERVOIR

STORET NO. 2403

I. CONCLUSIONS

A. Trophic Condition:

Based upon field observations and survey data, Liberty Reservoir is considered early mesotrophic. Survey limnologists reported that the water was clear, appearing light green in color, with no visible aquatic plants and an algal bloom occurring only in the spring.

Chlorophyll a levels ranged from a low of 3.0 micrograms per liter in the spring to a high of 14.4 micrograms per liter in the fall with a mean of 6.3 micrograms per liter.

The lake was characterized by high concentrations of total phosphorus.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Liberty Reservoir was limited by available phosphorus levels. Spikes with phosphorus, or nitrogen and phosphorus simultaneously result in increases in assay yield. Additions of nitrogen alone did not stimulate a growth response. The ratio of available nitrogen to phosphorus in sampled waters substantiates phosphorus limitation.

C. Nutrient Controllability:

1. Point sources -

The nutrient loading rate of 0.37 $g/m^2/yr$ to Liberty Reservoir is one-third of the "permissible" level proposed by Vollenweider (in press). Point sources contribute 4.0% of the total phosphorus loading. Total elimination of known point sources could result in maintaining the present high quality of the water.

2. Nonpoint sources -

The total phosphorus load from nonpoint sources accounted for 96.0% of the loading reaching Liberty Reservoir; major tributaries contributed 73.0%, while minor tributaries and immediate drainage contributed 18.4%. According to the State of Maryland Sanitary Survey, 1970, agricultural pollution was most prevalent. Also observed contributing to the loading of the reservoir were surface oil storage, surface scavenger dumping, incorrectly located storm drains, and numerous types of dumps.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake surface area and volume were obtained from "Reservoirs in the United States." Mean depth was determined by dividing the volume by the lake surface area. Tributary data were provided by the Maryland District Office of the U.S. Geological Survey (USGS) (outlet drainage area includes the lake surface area). The outlet data for normalized flow and daily and monthly flows for time of sampling were dividied into spillage and diversion segments. The spillage and diversions were combined into total outflow. Mean hydraulic retention time was obtained by dividing the lake volume by the mean flow of the outlet.

Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix D.

A. Lake Morphometry:

1. Surface area: 12.59 km^2.
2. Mean depth: 12.7 meters.
3. Maximum depth: unknown.
4. Volume: 15.926 x 10^6 m^3.
5. Mean hydraulic retention time: 40 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
A(1) N. Branch Patapsco River	146.6	1.7
B(1) Little Morgan Run	22.5	0.3
C(1) Morgan Run	75.4	0.8
D(1) Middle Run	21.9	0.3
E(1) Beaver Run	37.6	0.4
Minor tributaries & immediate drainage -	108.1	1.4
Totals	412.1	4.9

2. Outlet -

A(1) N. Branch Patapsco River	424.8	4.6

C. Precipitation:

1. Year of sampling: 114.2 centimeters.

2. Mean annual: 106.3 centimeters.

III. LAKE WATER QUALITY SUMMARY

Liberty Reservoir was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from four stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first visit, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 41.1 meters at station 1, 7.6 meters at station 2, 16.2 meters at station 3, and 7.6 meters at station 4. For a more detailed explanation of National Eutrophication Survey methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix B and are summarized in III A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III B. Results of the limiting nutrient study are presented in III C.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LIBERTY RESERVOIR
STORET CODE 2403

PARAMETER	1ST SAMPLING (4/11/73) 4 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/20/73) 4 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 1/73) 4 SITES RANGE	MEAN	MEDIAN
TEMP (C)	7.1 - 10.8	9.5	9.8	5.8 - 27.9	16.8	15.8	8.0 - 21.8	15.9	19.4
DISS OXY (MG/L)	8.2 - 11.6	10.6	10.4	0.2 - 13.0	5.7	6.9	0.1 - 9.4	4.6	5.3
CNDCTVY (MCROMO)	98. - 135.	118.	115.	68. - 143.	96.	93.	74. - 139.	103.	103.
PH (STAND UNITS)	6.3 - 7.0	6.7	6.6	6.6 - 9.1	7.5	7.1	6.3 - 8.1	4.8	6.7
TOT ALK (MG/L)	17. - 29.	25.	26.	19. - 42.	26.	27.	21. - 60.	33.	30.
TOT P (MG/L)	0.012 - 0.077	0.032	0.026	0.009 - 0.047	0.017	0.013	0.009 - 0.129	0.031	0.020
ORTHO P (MG/L)	0.004 - 0.023	0.009	0.007	0.004 - 0.009	0.006	0.006	0.004 - 0.011	0.006	0.005
NO2+NO3 (MG/L)	1.500 - 2.400	1.974	1.900	0.870 - 2.300	1.768	1.750	0.340 - 1.900	1.375	1.465
AMMONIA (MG/L)	0.030 - 0.150	0.080	0.070	0.040 - 0.810	0.128	0.070	0.030 - 1.240	0.256	0.085
KJEL N (MG/L)	0.300 - 0.900	0.470	0.500	0.200 - 1.000	0.555	0.600	0.200 - 2.200	0.759	0.700
INORG N (MG/L)	1.540 - 2.550	2.054	1.960	1.610 - 2.480	1.896	1.805	1.190 - 1.960	1.631	1.590
TOTAL N (MG/L)	1.800 - 3.300	2.443	2.200	1.800 - 3.000	2.323	2.300	1.670 - 2.540	2.134	2.090
CHLRPYL A (UG/L)	2.8 - 5.8	4.3	4.3	5.1 - 10.4	7.7	7.7	3.7 - 14.4	6.9	4.8
SECCHI (METERS)	0.5 - 1.4	0.8	0.7	3.0 - 5.5	3.8	3.4	1.7 - 4.6	2.9	2.6

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera		Algal Units per ml
04/11/73	1.	Flagellates	765
	2.	Melosira	325
	3.	Cryptomonas	314
	4.	Asterionella	42
	5.	Navicula	31
		Other genera	51
		Total	1,528
07/20/73	1.	Fragilaria	1,643
	2.	Melosira	810
	3.	Synedra	476
	4.	Cryptomonas	143
	5.	Stephanodiscus	119
		Other genera	240
		Total	3,431
10/01/73	1.	Blue-green filament	1,421
	2.	Fragilaria	863
	3.	Cyclotella	360
	4.	Melosira	342
	5.	Cryptomonas	198
		Other genera	684
		Total	3,844

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (micrograms/Liter)
04/11/73	1	5.7
	2	3.0
	3	5.8
	4	2.8
07/20/73	1	9.1
	2	5.1
	3	6.3
	4	10.4
10/01/73	1	3.7
	2	4.2
	3	5.4
	4	14.4

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.025	0.306	2.2
0.05 P	0.075	0.306	23.8
0.05 P + 1.0 N	0.075	1.306	24.9
1.00 N	0.025	1.306	1.5

2. Discussion -

The results of the algal assay with Selenastrum capricornutum indicate that the potential for primary production in Liberty Reservoir was high at the time of sampling. Increased growth of the test alga in response to an addition of orthophosphorus indicates that the lake was phosphorus limited when sampled. Spikes with nitrogen and phosphorus simultaneously resulted in maximum yield. The addition of nitrogen alone did not stimulate growth beyond the control yield.

The total available nitrogen to dissolved phosphorus ratio of 244:1 further indicates phosphorus limitation.

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Maryland National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of February when two samples were collected. Sampling was begun in May 1973, and was completed in May 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Maryland District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of the USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loading for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean of the nutrient loads, in $kg/km^2/year$, at stations B(1) and C(1) and multiplying the means by the ZZ area in km^2.

The operator of the Finksburg A.T. & T., Montrose Girls School, and Black and Decker-#2 wastewater treatment plants provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Population Served *	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Finksburg A.T. & T.	7	Extended Aeration	0.003**	Roaring Run Stream, N. Branch Patapsco River
Montrose Girls School	300	Trickling filter	0.076	Unnamed stream, N. Branch Patapsco River

2. Known industrial -

Name	Product	Treatment	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Black and Decker-#2	Effluents from washing operations	Activated sludge	1.737	Deep Run Creek, N. Branch Patapsco River

*Provided by the State of Maryland.
**Estimated at 0.38 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source		kg P/yr	% of total
a.	Tributaries (nonpoint load) -		
	A(2) N. Branch Patapsco River	2,210	47.1
	B(1) Little Morgan Run	225	4.8
	C(1) Morgan Run	460	9.8
	D(1) Middle Run	185	3.9
	E(1) Beaver Run	345	7.4
b.	Minor tributaries & immediate drainage (nonpoint load) -	864	18.4
c.	Known municipal STP's -		
	Finksburg A.T. & T.	<1	<0.1
	Montrose Girls School	145	3.1
d.	Septic tanks* -	5	0.1
e.	Known industrial -		
	Black and Decker-#2	35	0.8
f.	Direct precipitation** -	220	4.7
	Total	4,695	100.0

2. Outputs - A(1) N. Branch Patapsco R. 2,215

3. Net annual P accumulation - 2,480 kg.

*Estimate based upon 27 lakeside dwelling.
**Estimated (see NES Working Paper No. 175).

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A(2) N. Branch Patapsco River	149,545	35.2
B(1) Little Morgan Run	20,660	4.9
C(1) Morgan Run	64,410	15.1
D(1) Middle Run	23,765	5.6
E(1) Beaver Run	39,360	9.3
b. Minor tributaries & immediate drainage (nonpoint load) -	95,975	22.6
c. Known municipal STP's -		
Finksburg A.T. & T.	25	<0.1
Montrose Girls School	345	0.1
d. Septic tanks * -	10	<0.1
e. Known industrial -		
Black and Decker-#2	17,695	4.2
f. Direct precipitation** -	13,590	3.1
Total	425,380	100.0

2. Outputs - A(1) N. Branch Patapsco R. 232,840

3. Net annual N accumulation - 192,540 kg.

*Estimated based upon 27 lakeside dwellings.
**Estimated (see NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
A(2) N. Branch Patapsco River	16	1,020
B(1) Little Morgan Run	10	918
C(1) Morgan Run	6	854
D(1) Middle Run	8	1,085
E(1) Beaver Run	9	1,047

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Yearly Phosphorus Loading Rate (grams/m^2/year)
Estimated loading rate for Liberty Reservoir	0.37
Vollenweider's "dangerous" or eutrophic rate	2.03
Vollenweider's "permissible" or oligotrophic rate	1.01

V. LITERATURE REVIEWED

Maryland Department of Health. 1970. "Liberty Reservoir Watershed Sanitary Survey."

U.S. Environmental Protection Agency. 1975. "National Eutrophication Survey Methods 1973-1976." Working Paper No. 175. NERC, Las Vegas, NV and PNERL, Corvallis, OR.

U.S. Geological Survey. 1966. "Reservoirs of the United States." USGS Paper No. 1838.

Vollenweider, Richard A. (in press). "Input-Output Models." Schweiz Z. Hydrol.

VI. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2403 LIBERTY RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 424.8

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2403A1	424.8	0.37	1.27	2.01	1.81	1.08	0.57	1.05	0.57	0.31	0.22	0.37	0.45	0.84
2403A2	146.6	1.93	2.35	2.69	2.29	2.04	1.59	1.36	1.25	0.91	0.91	1.30	1.53	1.67
2403B1	22.5	0.28	0.34	0.40	0.34	0.31	0.25	0.22	0.20	0.16	0.15	0.21	0.24	0.26
2403C1	75.4	0.96	1.25	1.44	1.22	1.02	0.76	0.62	0.57	0.37	0.37	0.59	0.71	0.82
2403D1	21.9	0.31	0.40	0.42	0.37	0.34	0.26	0.22	0.21	0.15	0.15	0.22	0.25	0.27
2403E1	37.6	0.51	0.65	0.76	0.62	0.54	0.40	0.34	0.31	0.20	0.20	0.31	0.37	0.43
2403F1	424.8	3.43	3.14	3.23	3.40	3.68	4.25	4.22	4.08	3.99	3.68	3.77	3.62	3.71
2403ZZ	121.0	1.56	1.93	2.21	1.87	1.67	1.30	1.13	1.02	0.74	0.74	1.08	1.25	1.37

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 424.8
SUM OF SUB-DRAINAGE AREAS = 424.8

TOTAL FLOW IN = 58.11
TOTAL FLOW OUT = 54.56

NOTE *** SEE WRITE-UP ON LIBERTY RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2403A1	5	73	4.62	12	1.42				
	6	73	2.27	9	2.07				
	7	73	0.31	14	0.03				
	8	73	0.03	11	0.03				
	9	73	0.0	8	0.0				
	10	73	0.0	6	0.0				
	11	73	0.0	11	0.0	15	0.0		
	1	74	0.0	12	0.0				
	2	74	0.0	9	0.0	23	0.0		
	3	74	0.0	9	0.0				
	4	74	0.0	13	0.0				
2403A2	5	73	3.71	12	2.55				
	6	73	2.83	9	3.09				
	7	73	1.56	14	1.36				
	8	73	1.36	11	1.16				
	9	73	1.33	8	0.82				
	10	73	1.02	6	0.96				
	11	73	0.82	11	0.68				
	1	74	2.69	12	3.88				
	2	74	1.61	9	1.61	23	1.61		
	3	74	1.93	9	1.39				
	4	74	3.34	13	5.92				

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2403 LIBERTY RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2403B1	5	73	0.51	12	0.37				
	6	73	0.40	9	0.42				
	7	73	0.25	14	0.22				
	8	73	0.22	11	0.19				
	9	73	0.22	8	0.14				
	10	73	0.17	6	0.16				
	11	73	0.14	11	0.12				
	1	74	0.40	12	0.54				
	2	74	0.25	9	0.25	23	0.25		
	3	74	0.28	9	0.22				
	4	74	0.45	13	0.74				
2403C1	5	73	2.21	12	1.39				
	6	73	1.59	9	1.70				
	7	73	0.74	14	0.62				
	8	73	0.62	11	0.51				
	9	73	0.62	8	0.34				
	10	73	0.45	6	0.40				
	11	73	0.34	11	0.27				
	1	74	1.47	12	2.35				
	2	74	0.79	9	0.79	23	0.79		
	3	74	0.96	9	0.65				
	4	74	1.98	13	3.96				
2403D1	5	73	0.59	12	0.42				
	6	73	0.45	9	0.51				
	7	73	0.25	14	0.22				
	8	73	0.22	11	0.19				
	9	73	0.22	8	0.14				
	10	73	0.17	6	0.16				
	11	73	0.14	11	0.11				
	1	74	0.42	12	0.62				
	2	74	0.26	9	0.26	23	0.26		
	3	74	0.31	9	0.23				
	4	74	0.54	13	0.93				
2403E1	5	73	1.13	12	0.74				
	6	73	0.82	9	0.91				
	7	73	0.40	14	0.34				
	8	73	0.34	11	0.27				
	9	73	0.31	8	0.18				
	10	73	0.24	6	0.22				
	11	73	0.18	11	0.14				
	1	74	0.76	12	1.22				
	2	74	0.40	9	0.40	23	0.40		
	3	74	0.51	9	0.34				
	4	74	1.02	13	1.98				

TRIBUTARY FLOW INFORMATION FOR MARYLAND 9/16/75

LAKE CODE 2403 LIBERTY RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2403F1	5	73	6.00	12	6.77				
	6	73	5.75	9	6.74				
	7	73	5.32	14	5.55				
	8	73	5.38	11	5.66				
	9	73	7.28	8	7.22				
	10	73	6.88	6	6.97				
	11	73	6.09	11	4.36	15	5.41		
	1	74	6.03	12	5.86				
	2	74	5.97	9	5.95	23	5.86		
	3	74	5.97	9	5.75				
	4	74	6.31	13	5.95				
2403Z7	5	73	3.06	12	2.10				
	6	73	2.32	9	2.55				
	7	73	1.27	14	1.13				
	8	73	1.13	11	0.96				
	9	73	1.10	8	0.68				
	10	73	0.85	6	0.79				
	11	73	0.68	11	0.57				
	1	74	2.21	12	3.20				
	2	74	1.33	9	1.33	23	1.33		
	3	74	1.59	9	1.13				
	4	74	2.69	13	4.81				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/04/16

240301
39 22 50.0 076 53 36.0
LIBERTY RESERVOIR
24013 MARYLAND

LIEPALES
3

2111202
0124 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/11	10 50	0069	9.2		54	115	6.80	25	0.060	0.500	1.790	0.007
	10 50	0006	9.2	11.6		113	6.90	24	0.030	0.300	1.700	0.005
	10 50	0015	9.2	11.4		112	6.60	23	0.030	0.300	1.600	0.006
	10 50	0025	9.1	11.5		112	6.80	24	0.030	0.300	1.700	0.005
	10 50	0040	8.9	11.3		112	6.80	25	0.030	0.300	1.600	0.005
	10 50	0065	7.5	11.2		113	6.90	26	0.040	0.300	1.500	0.005
	10 50	0080	7.2	11.1		115	6.90	26	0.050	0.300	1.500	0.005
	10 50	0100	7.1	11.3		115	6.60	26	0.050	0.300	1.500	0.004
	10 50	0120	7.0	11.0		115	7.00	26	0.060	0.500	1.500	0.011
73/07/20	16 00	0000	26.7	8.2	216	101		22	0.110	0.600	1.580	0.008
	16 00	0010	26.6			104						
	16 00	0015	25.6	9.6		103		22	0.070	0.200	1.600	0.005
	16 00	0020	20.2	13.0		93	8.80	19	0.070	0.200	1.700	0.006
	16 00	0025	15.8			83						
	16 00	0030	13.1			79						
	16 00	0040	9.3			72						
	16 00	0050	7.7	7.4		70		20	0.040	0.200	1.800	0.006
	16 00	0060	7.1			69						
	16 00	0070	6.8			69						
	16 00	0080	6.4	7.8		68		20	0.040	0.200K	1.700	0.004
	16 00	0090	6.1			68						
	16 00	0100	6.0			68						
	16 00	0110	5.9	5.5		68	6.70	23	0.050	0.200K	1.700	0.006
	16 00	0120	5.8	1.6		69						
	16 00	0130	5.8	1.0K		77						
	16 00	0135	5.8	0.2		86	6.80	42	0.810	1.000	0.870	0.007
73/10/01	14 05	0000	21.8	8.0	180	102	7.50	36	0.070	0.500	1.470	0.007
	14 05	0020	21.7	8.0		104	6.80	26	0.050	0.200K	1.470	0.006
	14 05	0030	17.0	2.0		94	6.50	25	0.060	0.200K	1.900	0.005
	14 05	0040	11.5	1.8		82	6.40	22	0.030	0.200K	1.740	0.005
	14 05	0050	8.7	4.0		76	6.40	21	0.030	0.200	1.810	0.005
	14 05	0060	7.4	5.2		74	6.40	23	0.050	0.200	1.880	0.005
	14 05	0080	6.6	5.6		74	6.30	24	0.030	0.300	1.830	0.005
	14 05	0100	6.1	1.2		74	6.30	27	0.090	0.300	1.530	0.006
	14 05	0128	6.0	0.2		94	6.40	50	1.130	1.300	0.410	0.006

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240301
39 22 50.0 076 53 36.0
LIBERTY RESERVOIR
24013 MARYLAND

11EPALES 2111202
3 0124 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/11	10 50	0000	0.016	5.7
	10 50	0006	0.016	
	10 50	0015	0.017	
	10 50	0025	0.016	
	10 50	0040	0.016	
	10 50	0065	0.012	
	10 50	0080	0.014	
	10 50	0100	0.013	
	10 50	0120	0.015	
73/07/20	16 00	0000	0.013	9.1
	16 00	0015	0.010	
	16 00	0020	0.012	
	16 00	0050	0.009	
	16 00	0080	0.009	
	16 00	0110	0.009	
	16 00	0135	0.018	
73/10/01	14 05	0000	0.011	3.7
	14 05	0020	0.011	
	14 05	0030	0.010	
	14 05	0040	0.009	
	14 05	0050	0.010	
	14 05	0060	0.009	
	14 05	0080	0.009	
	14 05	0100	0.011	
	14 05	0128	0.021	

22
A

STORET RETRIEVAL DATE 75/09/16

240302
39 26 12.0 076 56 06.0
LIBERTY RESERVOIR
24013 MARYLAND

11EPALES
3

2111202
0028 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/11	11 35	0000	9.9		18	100	6.90	17	0.070	0.400	1.900	0.006
	11 35	0006	9.9	10.4		98	6.70	21	0.060	0.300	1.900	0.006
	11 35	0015	9.8	10.4		98	6.60	20	0.060	0.300	1.900	0.006
	11 35	0024	9.2	10.4		100	6.40	20	0.070	0.400	1.800	0.006
73/07/21	11 40	0000	27.2		144	101	7.80	22	0.060	0.800	1.700	0.009
	11 40	0005	27.1	8.8		100	7.60	21	0.040	0.600	1.700	0.006
	11 40	0015	25.4	6.6		91	7.10	19	0.060	0.500	1.700	0.005
	11 40	0025	15.8	0.2		81	6.60	27	0.160	0.600	1.500	0.005
73/10/01	15 00	0000	21.6	8.2	84	99	6.70	26	0.050	0.700	1.450	0.006
	15 00	0015	21.5	8.4		98	6.70	26	0.060	0.500	1.460	0.005
	15 00	0023	21.0	8.0		97	6.70	26	0.060	0.600	1.480	0.005

STORET RETRIEVAL DATE 75/09/16

240302
39 26 12.0 076 56 08.0
LIBERTY RESERVOIR
24013 MARYLAND

11EPALES 2111202
3 0028 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/11	11 35	0000	0.026	3.0
	11 35	0006	0.027	
	11 35	0015	0.025	
	11 35	0024	0.033	
73/07/21	11 40	0000	0.011	5.1
	11 40	0005	0.012	
	11 40	0015	0.019	
	11 40	0025	0.034	
73/10/01	15 00	0000	0.012	4.2
	15 00	0015	0.015	
	15 00	0023	0.051	

STORET RETRIEVAL DATE 75/09/16

240303
39 27 00.0 076 52 38.0
LIBERTY RESERVOIR
24013 MARYLAND

11EPALES
3

2111202
0054 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/11	12 00	0000	10.8		36	115	7.00	27	0.100	0.600	2.400	0.008
	12 00	0006	10.8	10.4		135	6.40	26	0.100	0.600	2.400	0.008
	12 00	0015	10.7	9.3		130	6.40	25	0.100	0.500	2.400	0.012
	12 00	0025	10.7	10.3		130	6.50	26	0.100	0.600	2.400	0.008
	12 00	0035	10.7	11.3		132	6.50	26	0.090	0.500	2.400	0.008
	12 00	0050	8.0	8.2		128	6.50	26	0.140	0.500	2.200	0.011
73/07/20	17 15	0000	27.9	8.5	120	125	8.40	28	0.070	0.800	1.900	0.005
	17 15	0005	27.4			125	8.40					
	17 15	0010	26.8	9.3		126	8.40	27	0.050	0.400	1.900	0.006
	17 15	0015	25.2	6.9		134	6.80	32	0.130	0.600	2.100	0.008
	17 15	0020	21.4			125	6.80					
	17 15	0025	15.6	1.0		100	6.70	28	0.070	0.400	2.300	0.004
	17 15	0030	13.4			92	6.80					
	17 15	0040	9.5			85	7.10					
	17 15	0050	8.0	0.7		93	7.10	35	0.310	0.900	1.800	0.006
73/10/01	15 25	0000	21.8	8.4	120	115	7.70	30	0.100	0.700	1.300	0.005
	15 25	0015	21.3	7.0		118	7.20	30	0.140	0.700	1.230	0.004
	15 25	0025	20.2	3.2		126	6.90	34	0.300	1.000	1.220	0.004
	15 25	0030	18.7	1.2		126	6.80	39	0.470	1.200	1.170	0.004
	15 25	0035	14.3	0.1		105	6.50	35	0.240	0.900	1.630	0.005
	15 25	0045	10.2	0.2		112	6.50	51	0.620	1.500	0.650	0.006
	15 25	0053	9.2	0.4		114	6.70	60	1.240	2.200	0.340	0.005

STORET RETRIEVAL DATE 75/09/16

240303
39 27 00.0 076 52 38.0
LIBERTY RESERVOIR
24013 MARYLAND

11EPALES 2111202
3 0054 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/11	12 00	0000	0.040	5.8
	12 00	0006	0.028	
	12 00	0015	0.035	
	12 00	0025	0.038	
	12 00	0035	0.040	
	12 00	0050	0.015	
73/07/20	17 15	0000	0.011	6.3
	17 15	0010	0.013	
	17 15	0015	0.020	
	17 15	0025	0.014	
	17 15	0050	0.021	
73/10/01	15 25	0000	0.019	5.4
	15 25	0015	0.023	
	15 25	0025	0.027	
	15 25	0030	0.031	
	15 25	0035	0.022	
	15 25	0045	0.055	
	15 25	0053	0.094	

STORET RETRIEVAL DATE 75/09/16

240304
39 28 01.0 076 53 15.0
LIBERTY RESERVOIR
24013 MARYLAND

11EPALES
3

2111202
0029 FEET DEP...

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/11	12	30 0000	10.8		20	130	6.30	28	0.150	0.900	2.400	0.021
	12	30 0006	10.8	10.0		130	6.40	29	0.140	0.700	2.300	0.018
	12	30 0015	10.6	9.8		130	6.80	29	0.150	0.700	2.300	0.017
	12	30 0025	10.7	9.8		132	6.40	28	0.140	0.700	2.400	0.023
73/07/21	12	15 0000	27.6		120	131	9.10	29	0.040	0.800	1.800	0.005
	12	15 0005	27.1	10.2		131	8.90	27	0.040	0.600	1.800	0.007
	12	15 0015	24.9	7.0		138	7.30	31	0.140	0.700	2.100	0.006
	12	15 0023	18.8	1.2		143	6.90	34	0.200	0.800	2.200	0.009
73/10/01	17	05 0000	21.5	9.4	66	114	8.10	33	0.080	1.300	1.110	0.011
	17	05 0015	21.0	6.1		118	7.20	37	0.180	1.200	1.220	0.007
	17	05 0025	20.2	5.4		139	6.90	39	0.280	0.800	1.680	0.010

STORET RETRIEVAL DATE 75/09/16

240304
39 28 01.0 076 53 15.0
LIBERTY RESERVOIR
24013 MARYLAND

11EPALES 2111202
3 0029 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/11	12 30	0000	0.077	2.8
	12 30	0006	0.070	
	12 30	0015	0.076	
	12 30	0025	0.068	
73/07/21	12 15	0000	0.016	10.4
	12 15	0005	0.020	
	12 15	0015	0.030	
	12 15	0023	0.047	
73/10/01	17 05	0000	0.035	14.4
	17 05	0015	0.058	
	17 05	0025	0.129	

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/09/16

2403A1
39 21 55.0 076 53 10.0
N BRANCH PATAPSCO RIVER
24023 7.5 SYKESVILLE
O/LIBERTY RESERVOIR
BRDG ON SEC RD 1.5 MI NE OF MARRIOTSVILE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	14 40		1.820	0.790	0.046	0.006	0.020
73/06/09	12 30		1.700	0.350	0.030	0.005K	0.015
73/07/14			0.780	0.250	0.035	0.005K	0.010
73/08/11	11 50		0.018	0.300	0.018	0.013	0.020
73/09/08	11 50		0.036	0.410	0.024	0.005K	0.035
73/10/06	12 00		0.039	0.110	0.021	0.005K	0.035
73/11/11	11 10		0.056	0.250	0.020	0.012	0.035
74/01/12	10 40		0.104	0.600	0.036	0.008	0.015
74/02/09	12 54		0.910	0.100K	0.005K	0.010	0.010
74/02/23	11 05		2.900	0.800	0.010	0.010	0.015
74/03/09	11 10		0.060	0.200	0.005K	0.005K	0.040
74/04/13	11 15		0.052	0.200	0.020	0.005K	0.020
74/05/11	11 15		0.044	0.200	0.015	0.005K	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2403A2
39 31 10.0 076 52 40.0
N BRANCH PATAPSCO RIVER
24 7.5 WESTMINSTER
I/LIBERTY RESERVOIR
BRDG ON SEC RD NEAR LAWNDALE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	12 00		2.800	0.100K	0.021	0.007	0.020
73/06/09	11 00		2.800	0.100K	0.017	0.013	0.045
73/07/14	09 15		2.800	0.440	0.017	0.005K	0.015
73/08/11	09 50		2.500	0.380	0.016	0.016	0.025
73/09/08	10 10		2.400	0.340	0.016	0.011	0.035
73/10/06	09 40		2.200	0.100K	0.018	0.019	0.035
73/11/11	10 05		2.700	0.300	0.020	0.036	0.045
74/01/12	09 20		2.500	0.700	0.116	0.056	0.120
74/02/09	10 57		3.900	0.100K	0.015	0.060	0.075
74/02/23	10 00		0.088	0.300	0.020	0.005K	0.030
74/03/09	10 00		2.900	0.300	0.010	0.010	0.040
74/04/13	09 55		2.800	0.300	0.020	0.025	0.045
74/05/11	10 00		2.500	0.600	0.065	0.005	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240381
39 25 40.0 076 57 40.0
LITTLE MORGAN RUN
24 7.5 FINKSBURG
T/LIBERTY RESERVOIR
BRDG ON SEC RD .75 MI N OF JOHNSVILLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	14 05		2.200	0.350	0.030	0.005K	0.015
73/06/09	12 05		2.200	0.100K	0.012	0.010	0.040
73/07/14	10 45		2.200	0.130	0.017	0.005K	0.015
73/08/11	11 00		2.000	0.690	0.023	0.017	0.035
73/09/08	11 20		1.700	0.620	0.029	0.006	0.030
73/10/06	11 15		1.940	0.580	0.042	0.008	0.020
73/11/11	10 50		2.100	0.200	0.025	0.021	0.060
74/01/12	10 15		2.200	0.400	0.024	0.012	0.025
74/02/09	12 24		2.920	0.100K	0.005K	0.015	0.015
74/02/23	10 50		2.500	0.100K	0.010	0.005K	0.015
74/03/09	10 50		2.400	0.200	0.005	0.005	0.032
74/05/11	11 00		2.180	0.600	0.055	0.005	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2403C1
39 27 07.0 076 57 20.0
MORGAN RUN
24 7.5 FINKSBURG
T/LIBERTY RESERVOIR
BRDG ON SEC RD 1.5 MI SW OF GAMBER
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	13 55		2.200	0.480	0.031	0.005K	0.015
73/06/09	11 50		2.200	0.460	0.017	0.005K	0.020
73/07/14	10 35		2.300	0.280	0.011	0.005K	0.010
73/08/11	10 50		2.200	0.100K	0.009	0.010	0.020
73/09/08	11 00		1.790	0.100K	0.009	0.005K	0.010
73/10/06	10 45		1.900	0.100K	0.023	0.006	0.010
73/11/11	10 45		2.200	0.100K	0.020	0.007	0.025
74/01/12	10 12		1.900	0.300	0.036	0.012	0.030
74/02/09	12 02		2.800	0.100K	0.005	0.010	0.010
74/02/23	10 40		2.300	0.800	0.040	0.005K	0.010
74/03/09	10 45		2.200	0.300	0.005	0.005K	0.035
74/05/11	10 50		2.100	0.350	0.025	0.005K	0.005K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

240301
39 27 44.0 076 54 30.0
MIDDLE RUN
24 7.5 FINKSBURG
T/LIBERTY RESERVOIR
BRDG ON SEC RD 1.5 MI E OF GAMBER
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	13 30		2.300	0.480	0.026	0.005K	0.020
73/06/09	11 35		2.300	0.210	0.012	0.005K	0.020
73/07/14	10 15		2.600	0.180	0.022	0.005K	0.015
73/08/11	10 15		2.200	0.310	0.021	0.015	0.040
73/09/08	10 40		2.600	0.300	0.017	0.005K	0.015
73/10/06	10 20		2.400	0.110	0.028	0.008	0.010
73/11/11	10 30		2.600	0.100K	0.018	0.007	0.020
74/01/12	09 50		2.100	0.300	0.028	0.008	0.025
74/02/09	11 45		2.940	0.500	0.015	0.015	0.015
74/02/23	10 25		2.400	0.200	0.010	0.005K	0.015
74/03/09	10 25		2.520	0.300	0.015	0.005K	0.040
74/04/13	10 55		1.800	0.800	0.035	0.010	
74/05/11	10 35		2.200	1.200	0.065	0.005K	0.005K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2403E1
39 29 14.0 076 54 05.0
BEAVER RUN
24 7.5 FINKSBURG
T/LIBERTY RESERVOIR
BRDG ON RT 91 .5 MI SW OF FINKSBURG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/12	13	15	2.700	0.110	0.022	0.005K	0.015
73/06/09	11	15	2.600	0.210	0.012	0.008	0.030
73/07/14	10	00	2.800	0.100K	0.016	0.005K	0.010
73/08/11	10	00	2.280	0.230	0.016	0.012	0.025
73/09/08	10	30	2.300	0.220	0.032	0.005K	0.020
73/10/06	10	00	2.100	0.150	0.085	0.005K	0.015
74/01/16	09	35	2.300	0.700	0.140	0.028	0.075
74/02/04	11	14	3.400	0.100K	0.005	0.010	0.010
74/02/23	10	15	2.800	0.300	0.020	0.005	0.027
74/03/09	10	15	2.800	0.600	0.025	0.005	0.045
74/04/13	10	10	2.500	0.300	0.020	0.005	0.005
74/05/11	10	10	2.300	1.000	0.030	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2403F1
39 22 38.0 076 53 28.0
N BRANCH PATAPSCO RIVER
24 7.5 FINKSBURG
O/LIBERTY RESERVOIR
AT LIBERTY DAM
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/11/15	09 00		1.500	0.150	0.021	0.005K	0.020
73/11/29	09 30		1.420	0.200	0.016	0.005K	0.040
74/01/15	11 00		1.430	0.100	0.016	0.005K	0.010
74/01/31	09 15		1.260	0.200	0.048	0.008	0.008
74/02/14	14 00		1.440	0.100K	0.010	0.010	0.010
74/02/28	15 00		1.500	0.300	0.005	0.005K	0.025
74/03/15	11 30		1.520	0.300	0.015	0.005K	0.010
74/03/29	08 30		1.520	0.200	0.015	0.005K	0.010
74/04/15	16 00		1.520	0.500	0.015	0.005K	0.005
74/04/30	09 30		1.400	0.200	0.025	0.005K	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/16

2403XA EA2403XA P000007
39 31 25.0 076 54 10.0
FINKSBURG A.T. AND T.
24023 CARROLL COUNTY
T/LIBERTY RESERVOIR
ROARING RUN STREAM/N. BRANCH PATAPSCA RV
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/07/12	15 10		33.000		0.130	0.100	0.660		
73/08/31	10 30			0.790		0.110	0.260	0.0004	0.0004
73/09/28	16 00		30.000	1.800	0.043	0.220	0.260	0.0004	0.0004
73/10/31	15 30		56.000		0.062	0.390	0.280	0.0004	0.0004
73/11/30	13 00		68.000	0.100K	0.022	0.300	0.310	0.0004	0.0004
74/01/03	11 00		21.000	0.500K	0.040K	0.420	0.450	0.0004	0.0004
74/01/31	14 00		30.000	0.100	0.040	0.370	0.410	0.0004	0.0004
74/02/28	15 00		49.000	1.000K	0.050K	0.260	0.400	0.0004	0.0004
74/04/01	13 00		37.800	1.600	0.050K	0.182	0.410	0.0004	0.0004
74/04/30	11 00		64.000	1.000K	0.120	0.070	0.115	0.0003	0.0003
74/06/01	10 00		69.000	1.000K	0.050K	0.107	0.180	0.0004	0.0004
74/07/31	10 00		36.000	1.000K	0.160	0.020	0.058	0.0004	0.0004

K VALUE KNOWN TO BE
LESS THAN INDICATED

C-27

STORET RETRIEVAL DATE 75/09/16

240321 TF240321 P000300
39 31 27.0 076 51 22.0
MONTROSE GIRLS SCHOOL (RESISERTO
24013 CARROLL COUNTY
T/LIBERTY RESERVOIR
UNNAMED STREAM/N. BRANCH PATAPSCA RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/11	07 00								
CP(T)-			0.720	20.000	11.000	6.720	9.000		
73/06/11	16 00								
73/07/12	07 00								
CP(T)-			0.440	16.800	8.500	8.700	9.400	0.018	
73/07/12	15 00								
73/09/12	07 30								
CP(T)-			0.730	23.100	6.600	10.900	13.500	0.015	0.015
73/09/12	15 30								
73/10/15	08 00								
CP(T)-			0.960	23.000	12.000	10.100	13.250	0.015	0.016
73/10/15	15 00								
73/11/12	07 30								
CP(T)-			0.440	24.000	11.600	9.300	11.500	0.015	0.014
73/11/12	15 30								
73/12/27	07 30								
CP(T)-				7.500	3.000	2.500	3.600	0.011	0.012
73/12/27	16 00								
74/01/30	08 00								
CP(T)-			1.460	13.000	7.500	7.200	8.500	0.006	0.007
74/01/30	16 00								
74/02/26	08 00								
CP(T)-			1.000	17.000	8.500	7.600	9.000	0.007	0.006
74/02/26	16 00								
74/03/29	07 30								
CP(T)-			0.280	16.000	9.750	7.750	9.700	0.011	0.009
74/03/29	15 30								
74/04/30	07 00								
CP(T)-			2.520	23.000	11.000	7.000	9.700	0.018	0.001
74/04/30	15 00								
74/05/31	07 00								
CP(T)-			2.000	23.000	10.500	7.050	9.300	0.035	0.015
74/05/31	15 00								
74/06/28	07 00								
CP(T)-			0.720	20.000	10.500	5.100	7.200	0.025	0.016
74/06/28	15 00								

STORET RETRIEVAL DATE 75/09/16

240330
39 35 18.0 076 50 52.0
BLACK AND DECKER #1
24 CARROLL COUNTY
T/LIBERTY RESERVOIR
UNNAMED STR/DEEP RUN CRK/N BRNCH PATAPSA
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/14	09 00								
CP(T)-			18.800	3.100	0.210	0.250	3.150		
73/06/14	17 00								
73/07/11	09 00		12.000	0.540	0.080	3.100	5.200		
73/08/10	09 30		17.600	6.300	0.300	4.100	6.900	1.030	1.030
73/09/13	08 30		18.700	3.400	0.189	4.400	6.300	1.030	1.030
73/10/18	10 55		22.400	3.300	0.190	5.100	6.000	1.030	1.030
73/12/11	08 30		25.000	4.400	0.585	5.250	6.700	1.030	1.030
74/01/11	10 00		8.400	1.200	0.390	1.760	2.100	1.500	1.500
74/03/01	08 30		28.600	3.400	0.180	5.100	6.700	1.100	1.100
74/04/12	10 00		16.000	1.000K	0.095	4.900	5.250	1.100	1.100
74/07/10	10 00		11.900	6.700	0.860	6.900	10.500	1.100	1.100
74/08/13	08 45		17.600	6.000	0.720	13.500	16.000	1.100	1.100
74/09/10	09 00			13.000	0.610	6.000	14.000	1.100	1.100
74/10/08	10 00		15.000	4.000	0.057	7.000	8.100	1.100	1.100

K VALUE KNOWN TO BE
LESS THAN INDICATED

C
6
A

STORET RETRIEVAL DATE 75/09/16

240331 AS240331 P001000*
39 35 13.0 076 51 15.0
BLACK AND DECKER #2
24 CARROLL COUNTY
T/LIBERTY RESERVOIR
DEEP RUN CREEK/N. BRANCH PATAPSCA RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/14 CP(T)-	00 00								
73/06/14	24 00		15.000	1.100	0.140	0.500	2.600		0.090
73/07/11	08 30		8.400	1.900	0.090	2.500	3.100		
73/08/10	09 00		6.000	3.900	1.260	2.730	3.075	0.350	0.140
73/09/13	08 15		16.100	2.900	0.198	4.040	4.900	1.000	
73/10/18	10 50		16.600	3.800	0.180	5.300	6.400	1.050	1.050
73/12/11	08 45		23.000	3.800	0.580	5.500	6.600	1.500	1.500
74/01/11	09 30		24.000	3.600	0.340	4.000	4.600	0.553	0.490
74/03/01	08 00		26.000	3.400	0.280	4.800	6.200	0.553	0.400
74/04/12	10 15		1.000	1.000K	0.530	4.300	4.900	0.576	0.576
74/07/10	09 45		9.875	4.300	0.960	4.500	5.900	0.553	0.490
74/08/13	08 30		15.200	5.800	0.610	9.700	10.000	0.553	0.490
74/09/10	09 15		11.300	3.900	0.190	7.600	7.600	0.576	0.576
74/10/08	10 15		7.800	4.300	0.050K	6.400	7.600	0.553	0.490

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX D

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX E

PARAMETRIC RANKINGS OF LAKES

SAMPLED BY NES IN 1973

STATE OF MARYLAND

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	2402	DEEP CREEK LAKE	550
2	2403	LIBERTY RESERVOIR	268
3	2408	LOCH RAVEN RESERVOIR	215
4	2409	JOHNSON POND	167

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
2402	DEEP CREEK LAKE	0.011	0.450	382.167	6.150	14.800	0.005
2403	LIBERTY RESERVOIR	0.018	1.760	401.833	6.325	14.900	0.006
2408	LOCH RAVEN RESERVOIR	0.023	1.440	429.555	7.133	14.800	0.007
2409	JOHNSON POND	0.098	0.950	458.250	26.225	7.200	0.040

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
2402	DEEP CREEK LAKE	100 (3)	100 (3)	100 (3)	100 (3)	50 (1)	100 (3)	550
2403	LIBERTY RESERVOIR	67 (2)	0 (0)	67 (2)	67 (2)	0 (0)	67 (2)	268
2408	LOCH RAVEN RESERVOIR	33 (1)	33 (1)	33 (1)	33 (1)	50 (1)	33 (1)	215
2409	JOHNSON POND	0 (0)	67 (2)	0 (0)	0 (0)	100 (3)	0 (0)	167